THE VALUE OF AMMONIATED MOLASSES IN BEEF CATTLE WINTERING RATIONS

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1950

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1954

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INTRODUCTION

It has long been realized that non-protein nitrogen compounds can be an indirect source of protein for ruminants. Most of the early work in this field was done in Germany during World War I when protein feed supplies were low. The German scientists discovered that urea, a compound containing 46.7 per cent nitrogen, could be used to provide at least part of the protein in the ration of ruminants.

In the late 1930's interest became greater in the United States and during World War II more research was begun in several countries to determine the value of urea in livestock feedstuffs.

Monogastric animals can not synthesize protein from a simple nitrogenous compound but ruminants such as cattle and sheep have a large fore-stomach where feed is broken down before digestion into simpler compounds and re-combined into new ones by bacteria and other microorganisms naturally residing there.

The process of protein formation in the rumen is primarily a process of growth and multiplication of rumen bacteria. These organisms normally function to break down course, fibrous feed before digestion. The bacteria must have a supply of nitrogen to develop and multiply. Urea and possibly some ammoniated products can provide nitrogen for the bacteria so they can combine it with other nutrients to build their own body protein.

During the process of "bacterial synthesis of protein", the bacterial population greatly increases and many of the bacteria mix with the other feed residues and pass down the animal's

digestive tract. Here the protein in the bacteria is digested and absorbed in the same manner as feed protein.

PURPOSE

Bacterial synthesis of protein from urea proceeds in two major steps: 1) the urea is broken down to ammonia, and 2) the ammonia is combined with carbohydrate fragments to form protein in the bacterial cells.

The second step must keep pace with the first step to get the desired results because energy must be provided for the rapid growth and multiplication of the bacteria in addition to having the carbohydrate fragments present for protein synthesis.

With the foregoing statements in mind, it is plausible to think that ammoniated molasses could also be a potential source of nitrogen for ruminants. It seems that it would act in the same manner as urea except that the first step would be omitted and the molasses would be a readily available source of carbohydrate to provide carbohydrate fragments, or carbon chains, and energy for protein synthesis.

The purpose of this experiment was to compare the value of ammoniated molasses and cottonseed meal in a wintering ration for beef heifer calves in Kansas where sorghum silage constitutes a major part of the winter roughage.

A 16 per cent protein equivalent ammoniated molasses and a 33 per cent protein equivalent ammoniated invert molasses was used in this trial.

REVIEW OF LITERATURE

Most of the early work with non-protein nitrogen as a protein feed was done in Germany. Urea was the source of non-protein nitrogen used. In most of the early experiments, a normal ration was compared with a ration supplying the same starch energy values but with part of the protein nitrogen replaced by a non-protein nitrogen compound. The results were difficult to interpret because the minimum protein requirements of the animals were not known. It seems possible, therefore, that no dietary protein deficiency occurred even when protein replacement was highest.

In the late 1930's, workers in the United States became more interested and during World War II, interest increased in many countries because of a shortage of sources of protein for livestock.

It was soon learned that simple stomached animals could not utilize urea as a source of dietary nitrogen. Urea must first be broken down to ammonia and be converted by microbiological activity into proteins. These microorganisms, present in the rumen but not present in simple stomachs, are then passed further into the alimentary tract where the proteins are digested the same as plant and animal proteins.

Urea in Dairy Cattle Rations

Some work with urea was done in England in 1938 when Bartlett and Cotton (3) did some experimenting with dairy calves to secure evidence about the value of urea as a protein feed. The addition

of 0.127 pound per animal per day of urea to a diet supplying a limited amount of protein resulted in an extra daily live-weight increase of 0.24 pound per day. This increase was statistically significant and the animals appeared therefore to have utilized the urea in their metabolism.

Hart, et al. (21,22) obtained similar results at the Wisconsin station. They started a series of experiments in 1936 by feeding some calves a ration low in protein (6 per cent total protein) and then supplementing the low protein ration with urea to a level of 18 per cent crude protein (N x 6.25). Blood analyses were made after the calves were well on the ration to determine the level of total and serum protein, urea, and non-protein nitrogen. The control animal was metabolizing very much less nitrogen than the urea-fed animal and the latter was carrying a much higher urea level in the blood.

After 40 weeks on the experiment, gain in weight by the urea-fed animal was 290 pounds compared to 201 pounds for the control animal.

In a second experiment, Hart et al. fed different levels of urea to Holstein heifers. When 2.8 pounds of urea per 100 pounds of ration was fed--61 per cent of nitrogen from urea, and 4.3 pounds of urea per 100 pounds of ration--70 per cent of nitrogen from urea, diuresis was definite. When the animals were slaughtered, there was definite damage to the kidneys in the animal on the 70 per cent ration. When urea made up only 43 per cent and 61 per cent of the nitrogen of the ration, no kidney damage was

evident.

Loosli and McCay (29) determined that calves as young as two months of age were able to utilize urea when it was added to a diet containing only 4.4 per cent protein to raise the ration to 16.2 per cent crude protein level. Calves on the basal ration were in negative nitrogen balance whereas calves on the urea ration were in positive balance, retaining 24 to 36 per cent of the dietary nitrogen.

Rupel et al. and others (49) experimented with urea in the ration of dairy cows that were lactating. Some cows led in production of milk on a linseed meal ration while others led on the urea ration with average differences favoring linseed meal in too small a degree to be statistically significant. The ration contained a large amount of carbohydrates, so the urea functioned satisfactorily as a source of dietary nitrogen.

In respect to the weight of calves and breeding history, the urea ration appeared as efficient as the oil meal ration.

The composition of the milk, the flavor of the milk, and the composition of the blood were not different on the urea and the linseed oil meal rations.

In this experiment also, a test was made to determine the influence of added corn molasses on urea utilization for milk production. There was no sustained and positive efidence that molasses feeding on a grain ration improved the utilization of urea.

Urea in Beef Cattle Rations

In a series of experiments at Oklahoma, Briggs et al. (6,7,8) studied urea as a means of extending the available supply of protein supplement for beef cattle. Pellets were used in the studies. Pellets in which 25, 50, 75 and nearly 100 per cent of the supplemental nitrogen was furnished by urea were fed in metabolism stalls to yearling and two year old steers. Pellets containing no more than 50 per cent urea nitrogen were satisfactory in metabolism studies as compared to cottonseed meal of the same protein content. Low grade prairie hay was used as the basal ration in the metabolism studies.

Pellets in which 25 and 50 per cent of the nitrogen was provided by urea nitrogen have proven satisfactory as a source of supplemental protein in two dry lot studies with fattening calves. Pellets containing a high proportion of urea to provide practically all the supplemental nitrogen to steers appeared to be unpalatable. When steers were fed pellets that contained 25 and 50 per cent of the nitrogen from urea, results were comparable to cottonseed meal. However, the calves that were fed pellets that contained 50 per cent of the supplemental nitrogen from urea refused to eat all their supplement late in the trial. The pellets that contained 25 per cent of the supplemental nitrogen from urea were palatable throughout the entire trial.

There was little difference between lots in grain consumption or in feed required to produce 100 pounds of gain and average daily gains were nearly identical when pellets containing 25 per

cent and 50 per cent of the supplemental nitrogen from urea were fed. However, when pellets containing 85 per cent supplemental nitrogen from urea were fed and compared to cottonseed meal, gains were reduced by 0.32 pound per steer per day, and the concentrates necessary to produce 100 pounds of gain were increased by 67 pounds (Gallup et al., 19).

In wintering tests steers or heifers fed the pellets that contained 25 per cent supplemental nitrogen from urea wintered as well as those fed an equal amount of cottonseed meal with the exception of a single trial with heifer calves (19).

In further tests, 10 pregnant beef cows were satisfactorily wintered on dry range grass and a daily supplement of three pounds of the pellets that contained 25 per cent supplemental nitrogen from urea. No difficulties were encountered with any of the cows.

Eight head of breeding bulls were wintered on the range and fed an average of 2.9 pounds of oats, and 12.1 pounds of prairie hay. The bulls gained satisfactorily during the 140 day wintering period and breeding efficiency was not impaired the following season.

In a series of digestion and nitrogen balance trials, Bell et al. (4) determined that urea nitrogen was utilized with equal efficiency in rations of different cereal grains and sweet potatoes, and with less efficiency in rations containing molasses. These results agree with work done by Tillman et al. (52) in which greater gains were made by steers receiving corn and cottonseed meal than by steers receiving urea and molasses.

Urea in Sheep Rations

Johnson et al. and others (24) concluded that the addition of urea to the basal ration in amounts to produce the equivalent of 12 per cent of crude protein on the dry basis induces a retention of nitrogen in growing lambs that can not be bettered by further urea additions, but can be bettered by raising the true protein content of the ration. It appears that the conversion of urea in the paunch is not rapid enough to cover the protein requirements of growing lambs.

The Oklahoma station (19) has made several studies with urea in sheep rations. In the case of urea being fed to pregnant and lactating ewes, although there were only slight differences in the average performance of ewes fed urea pellets as compared to those fed cottonseed meal pellets, the differences favored the latter group in every case.

In summer fattening trials, lambs failed to make efficient use of urea. However, lambs receiving the basal ration containing only 8.1 per cent crude protein made very satisfactory gains, so it is thought that this may have obscured any benefit derived from the urea.

Mechanisms of Urea Utilization

Many investigations have been made to determine the action of urea in the rumen ("in vivo").

By way of a fistula, Wegner et al. (57) removed aliquots of rumen material periodically for analysis throughout the day be-

ginning about an hour after the animal was fed. In a test where urea was added to a low protein basal ration, any protein synthesis would be more easily detected since the per cent of the newly formed protein would constitute a greater part of the total nitrogen. In this type of test, Wegner found that low protein rations gave more positive evidence of protein synthesis on additions of urea when 15 pounds of corn silage and three pounds of starch were used.

Wegner observed that ammonia nitrogen in the rumen was at a low level several hours after feeding, but the protein level of the rumen contents after adding urea was approximately 20 per cent higher. The increase in total nitrogen was due to the formation of protein nitrogen.

In subsequent studies, Wegner et al. (58) discovered that when large amounts of urea were added to a low protein concentrate, the rate of disappearance of ammonia from the rumen was much faster than when urea was added to high protein rations.

With every ration tried, it was found that the added urea-nitrogen was always hydrolyzed to ammonia within one hour after feeding.

Mills et al. (38) obtained results to indicate that only partial utilization of urea by ruminants occurs when molasses is the chief source of readily fermentable carbohydrates while Pearson and Smith (41, 42, 43) found that upon the incubation of rumen ingesta "in vitro" with urea and various carbohydrates, starch was most effective in causing synthesis of protein. Galactose and maltose were also good. Sucrose was fair while

dextrins, glucose, glycerol and lactic acid were relatively poor. Protein is formed in the rumen when molasses is used but the final level of protein reached is not as high as when a less soluble carbohydrate is in the ration.

More direct evidence supporting the earlier findings was reported recently by Watson et al. (56). Nitrogen-low diets supplemented with urea labeled with N^{15} were fed to sheep for four days, after which time they were slaughtered and the quantities of N^{15} in the protein and non-protein fractions of the kidneys, liver, and blood were measured. Since the quantity of N^{15} in these body proteins exceeded that found in the body proteins of similar sheep fed unlabeled urea, it was concluded that urea nitrogen is utilized in the formation of body proteins by ruminants.

Carbohydrates and Urea

The influence of carbohydrates on the conversion of urea nitrogen to protein was studied by Mills et al. (38) by measuring the amounts of protein and ammonia nitrogen in the rumen ingesta at different times after the feeding of various rations. When timothy hay was fed with urea, the level of protein in rumen ingesta was the same as that when the hay was fed alone or in combination with starch. However, the amount of ammonia nitrogen in the ingesta was higher when timothy hay and urea were fed than when timothy hay was fed alone or with starch. These findings suggested that timothy hay alone did not provide a suitable

medium for the bacterial synthesis of protein from urea. The addition of starch to the timothy hay-urea ration resulted in an increase in the protein content of the rumen ingesta.

McDonald (33) reported that the addition of starch to the rumen of sheep 20 hours after consuming a zein-containing diet (at which time the ammonia content of the ingesta was high) resulted in a rapid reduction in the ammonia content. This suggests that starch provided a source of energy needed by microorganisms to utilize ammonia.

In other experiments Wisconsin workers (39) studied the influence of molasses upon the synthesis of protein from urea. Timothy hay alone or in combination with molasses resulted in rumen ingesta containing 6.5 to 7.7 per cent of true protein. The addition of urea to a ration of molasses and timothy hay increased the true protein level of the rumen contents to 9.3 per cent. However, the addition of starch to a ration of timothy hay, molasses, and urea resulted in a further increase in true protein content to 11.0 per cent. Since these results indicated that the addition of starch to a ration promoted protein synthesis to a greater extent than did the molasses, a further experiment was conducted with growing heifers approximately 3.5 months old and weighing 200 pounds. A ration containing timothy hay, cane molasses, and urea and providing 11.6 per cent of protein equivalent, of which urea composed 60 to 65 per cent of the total nitrogen, resulted in an average daily gain of 0.72 pound of body weight in three heifers. When the same ration was sup-

plemented with 0.3 pound of starch, the daily body weight gain was 1.4 pounds. Since the same heifers were employed in both trials, an effect of age upon the gain in weight may have existed. Seven weeks elapsed between the first and second trials, which were of 19 and four weeks duration, respectively. Since it was suspected that the protein synthesized from the hay-molasses-urea ration may have been of poor quality, casein at the rate of 0.3 pound per day was added to a ration otherwise of the same composition as that used in the previous trial. This ration, providing 13.5 per cent of protein equivalent, resulted in an average daily gain of 1.6 pounds.

Workers at Cornell (5) recently completed a trial with 80 dairy heifers over a two year period to study the utilization of urea with molasses as the source of carbohydrate supplement. In every trial but one, animals that received a soybean oil meal ration with either corn or molasses gained significantly more than urea-supplemented animals.

The results of these feeding experiments as well as those of the experiment in which ruminal ingesta was studied, indicated that only partial utilization of urea by ruminants takes place when molasses is the main readily available carbohydrate fed and that starch is much more effective than molasses in the conversion of urea to protein. This may mean that the sugars of molasses are absorbed or passed from the rumen or degraded too rapidly to be of much use to the microorganisms. In an experiment with dairy cows, the addition of molasses to a ration containing timothy hay, corn silage, ground corn, and oats produced no signif-

icant effect upon the utilization of urea nitrogen, as evidenced by the quantity of milk produced (49).

Willet et al. (59) found that the substitution of 25 per cent of cane molasses for a portion of the pineapple bran in a ration for milking cows did not affect the utilization of urea, as determined by milk yield. The basal concentrate employed in these experiments also contained 21 to 22 per cent of both soybean meal and barley.

Harmful Effects of Urea

There is definite danger of toxicity from feeding non-protein nitrogen compounds to ruminants. An Oregon veterinarian reports on two cases of urea poisoning due to cows eating urea fertilizer (40). Isolated reports are often submitted by farmers indicating that under certain conditions urea caused undesirable results.

Urea toxicity has been induced in calves (19). Shortly after rapid ingestion of a concentrated urea-molasses mixture one affected animal appeared uneasy, tended to kick at its flank, and showed muscular tremors. This was followed by incoordination, staggering and depression. In cases of toxicity, a rapid increase in blood ammonia is noted. Dinning et al. (14) reported that severe tetany occurred in 500 pound steers when the ammonia nitrogen in the blood reached a level of 2 mg. per cent. Respiration became slow and difficult with frequent gasping and salivation became excessive and frothy. As the blood ammonia values increased, the tetany became more severe. The tetany

was relieved in one animal by giving an intravenous injection of 75 grams of equal parts of calcium chloride, magnesium chloride and dextrose. These workers suggested that the lethal level of blood ammonia nitrogen may be between 2 and 4 mg. per cent. The signs of ataxia and tetany are considered characteristic of alkalosis, which consists in excessive pH or bicarbonate, or both, in the plasma.

Diuresis was reported by Hart et al. (21) in Holstein heifers when urea was fed to provide 61 per cent and 70 per cent of the nitrogen in the ration. Damage to the kidneys was noted in the animal receiving the 70 per cent ration.

Other mishaps have resulted from urea in commercial feeds due to improper or incomplete mixing.

Ammoniated Products in Livestock Rations

The Quaker Oats Company pioneered in the field of ammoniated products for livestock feeds. About 1940 it was observed that ammoniated feeds were apparently palatable for ruminants (Millar, 36). Realizing that the process of ammoniating products was relatively easy and could be accomplished quite economically, the company started using ammoniated plant products as a source of dietary nitrogen for ruminants. Millar obtained a patent in 1942 for the ammoniation of "Agricultural Material as Livestock Feed" and assigned it to the Quaker Oats Company.

One of the first experiments with ammoniated products consisted of feeding ammoniated plain sugar beet pulp (Millar, 37). Animals receiving a basal ration low in protein made slow gains

while animals receiving the basal ration plus ammoniated beet pulp made normal gains.

Tillman and Kidwell (51) used a product known as condensed distillers molasses solubles and combined it with anhydrous ammonia to get a nitrogen level of approximately 13 per cent crude protein equivalent. In two trials with beef cattle, no significant differences in gain were noted when ammoniated condensed distillers solubles replaced 25 per cent and 50 per cent of the molasses in a normal ration for growing cattle. However, in both trials, the lots receiving the ration with 50 per cent ammoniated condensed distillers molasses made the lowest gains.

McCall and Graham (31, 32) had better results than Tillman and Kidwell. They did some work with several ammoniated products which included ammoniated cane molasses, ammoniated citrus pulp, and furameal--a by-product from the production of furfural. In all the studies the ammoniated products tested were satisfactory protein substitutes for fattening steers when fed to the level of 40 per cent of the protein supplement. No digestive disorders were noticed and the ammoniated products in the supplements appeared to be as palatable as the control supplement.

When ammoniated condensed distillers molasses solubles, ammoniated cane molasses and urea--262--were mixed with cerelose and a basal mixture composed of natural feedstuffs in such a way that the total rations were equal in calories and nitrogen and compared to soybean oil meal fed the same way to growing sheep, the following results were obtained by Tillman and Swift (53): 1) The ration constituents of the urea containing ration were

digested as well as those of the soybean oil meal ration. 2) The ammoniated products decreased the digestibility of all ration constituents except ether extract. The decrease was greatest in the case of nitrogen. 3) The sheep receiving either urea or soybean oil meal in their rations stored more nitrogen in their bodies than the sheep receiving the rations containing the ammoniated products. 4) The soybean oil meal ration contained the highest level of metabolizable energy and was followed in order by the urea, ammoniated condensed distillers molasses solubles and ammoniated cane molasses rations. 5) The urea ration promoted the lowest storage of carbon and body fat. 6) There was no loss of nitrogen from the rations containing urea or either ammoniated products when they were stored for a period of 120 days.

Recently Tillman and Gallup (55) attempted to evaluate ammoniated cane molasses and ammoniated furfural residue as protein and energy extenders.

The differences between the digestion coefficients were not significant at the five per cent level of probability, indicating that cattle are able to utilize these products almost as well as they utilize cottonseed meal.

Replacing one-third of the cottonseed meal with ammoniated molasses, on a protein equal basis, substantially increased the average daily gain for wintering beef cows on dry, native grass at Oklahoma (55). Spraying the ammoniated cane molasses on tall, native grass increased the intensity of grazing on the sprayed area, but resulted in less weight gain than when the molasses

was fed in bunks.

Pope et al. (45) used ammoniated cane molasses as a replacement for cottonseed meal in a fattening ration for steers. Steers fed the 16 per cent ammoniated cane molasses to replace one-half of the cottonseed meal, gained 2.10 pounds per head daily, while those fed the 33 per cent product made daily gains of 2.11 pounds. Both lots outgained the controls, which gained 1.95 pounds per head per day.

Steers of the molasses-fed lots exhibited keener appetites during the latter part of the test and those getting the 16 per cent molasses were noticeably fatter at the completion of the experiment. It was apparent that the 16 per cent product was more palatable than the 33 per cent protein equivalent ammoniated cane molasses, particularly during the last few weeks of the trial. The steers were fed sorghum silage as a source of roughage.

When a 37 per cent protein equivalent ammoniated molasses product was fed at a 10 per cent level in an 18 per cent protein grain ration replacing cottonseed meal for dairy steers, the steers made satisfactory growth over a 12 week period when fed grass hay and three pounds of the grain ration daily (Rusoff, 50). The control steers gained an average of 1.18 pounds per day while the molasses supplemented steers gained 1.30 pounds per head per day.

Contradictory results were obtained with yearling heifers when a 15 per cent crude protein equivalent ammoniated molasses was fed (King, 25). In this experiment the heifers receiving

ammoniated molasses gained only 0.92 pound per head per day in an 84 day trial compared to the 1.71 pounds per head daily gain of the control group in 112 days. The control group received straight cane molasses. When the cottonseed meal in the ration was increased from one pound to two pounds per head per day for the group originally getting ammoniated molasses, the average daily gain for the last 28 day period increased to 1.9 pounds per head.

This work agrees with work at Mississippi (Barrentine, 2) indicating that, for some unknown reason, the nitrogen in the ammoniated molasses does not become available for protein synthesis, and gains are consequently low. When adequate protein was added to the ration to meet the daily requirements, gains immediately increased.

A condition known as "stimulation" often results from feeding ammoniated products to livestock. The animals lose muscle coordination and walk with a staggering gait. They become very nervous and easily excited. In severe "stimulation" they often act in a crazy manner to the extent that they run into whatever objects may be in front of them. There have been many cases of "stimulation" from feeding ammoniated molasses to cattle in wintering rations, whereas, there have been no reports of "stimulation" when fed in fattening rations. The cause of the "stimulation" is unknown. Workers at Mississippi (Barrentine, 2) fed ammoniated molasses with hay as the roughage and got severe "stimulation". Then the ration was changed so that hay and silage comprised the

roughage. Severe "stimulation" was still obtained and the trial had to be discontinued.

The Louisiana workers (Rusoff, 50) did not get any "stimulation" in their work with dairy steers with a 37 per cent protein equivalent ammoniated molasses fed at a 10 per cent level in an 18 per cent protein grain ration replacing cottonseed meal.

King (25) reported a condition of incoordinated or staggering gait when a 15 per cent protein equivalent ammoniated molasses was fed to yearling heifers. No excitement was observed but one heifer showed this staggering gait, even after being off the feed for six weeks.

Toxicity studies were conducted at Louisiana (Rusoff, 50) on ammoniated molasses with mature albino rats. Administration directly into the stomach resulted in some distress for one to seven days after which the rats resumed increased feed intake and showed normal weight gains. Neutralization of the ammoniated molasses (pH 8.6) with lactic acid to pH 6.7 resulted in normal intakes and gains.

The patented process for ammoniation of molasses products calls for temperatures of approximately 130 degrees centigrade for about 15 minutes using gaseous ammonia under pressure. The chemistry of what happens is still obscure. It is believed that only the simple sugars are utilized in the reaction.

During the process of ammoniating cane molasses, the product becomes very alkaline. In order to neutralize the product so that it can be consumed without harm some type of acid must be

incorporated. To determine which kind of acid might be the best as a neutralizer, Knodt et al. (27) ran a number of trials using hydrochloric acid, phosphoric acid and sulfuric acid as neutralizers for ammoniated products. No differences could be found on the rate of growth from the various ammoniated products fed and the kind of acid used as a neutralizer.

Ammoniated citrus pulp prepared from citrus pulp treated with liquid ammonia has been fed at the Florida station to cattle ranging in age from five months to two years. Experiments by Davis et al. (12) have demonstrated that palatability is markedly affected by the method of preparation. Older cattle accept and utilize the product better than calves. In their trials they determined that 12 per cent crude protein ammoniated citrus pulp may supply up to 30 per cent of the total digestible nutrients for young cattle and up to 50 per cent of the total digestible nutrients for older cattle with efficient utilization of the non-protein nitrogen.

Trials by Magruder et al. (30) indicated that ammoniated products could be used satisfactorily for growth of dairy calves. One heifer was fed 60 per cent of an ammoniated molasses product before refusal and ill effects were negligible.

EXPERIMENTAL

Procedure

Forty head of good quality Hereford heifers were purchased for this trial. They originated from near Pueblo, Colorado, at a

purchase price of 17.5 cents a pound. Transportation cost about one cent a pound, so the overall cost of the heifers, delivered to the feeding pens at Kansas State College, was about 18.5 cents a pound.

Upon arriving, the heifers were given prairie hay for a few days and then placed on a ration of atlas sorgo silage, cottonseed meal and ground milo grain for about a week before the official beginning of the trial.

Each heifer was branded with a hot iron for identification purposed and on December 16, 1953, the heifers were divided as equally as possible by weight, type and appearance into four lots of ten heifers each. They were officially started on the trial on December 17.

The atlas sorgo silage used in this experiment was grown on the Kansas State College Experiment Station. It was a good quality silage that contained quite a lot of grain. It had a good silage odor and retained a lot of the original green color, indicating that the carotene content was adequate to provide enough vitamin A for wintering heifers.

The cottonseed meal contained 41 per cent crude protein, as indicated on the tag, and 41.6 per cent crude protein by chemical analysis.

The ground milo grain was a combine variety of grain sorghum normally raised in Kansas. It was coarsely ground before it was fed.

Two kinds of ammoniated molasses were used in this experiment. One kind (Molatein) contained 15 per cent crude protein by dis-

solving anhydrous ammonia in blackstrap molasses. The ammonia contributed 12 per cent crude protein equivalent while the blackstrap cane molasses originally contained 3 per cent crude protein. The other product contained 33 per cent protein equivalent which was obtained by inverting the sugars in the molasses and adding anhydrous ammonia. The ammonia in this product contributed 30 per cent crude protein equivalent and the molasses again contributed 3 per cent protein. Both products had a pH value of 7.

The daily ration used at the beginning of the experiment can be seen in Table 1. Lot 1 was the control group of heifers and received 200 pounds of atlas sorgo silage, 20 pounds of ground milo grain and 10 pounds of cottonseed meal. Lot 2 was given 200 pounds of atlas sorgo silage, 16 pounds of ground milo grain, 5 pounds of cottonseed meal and 14.7 pounds of 15 per cent protein equivalent ammoniated molasses. Lot 3 received 200 pounds of atlas sorgo silage, 20.2 pounds of ground milo grain, 5 pounds of cottonseed meal and 7 pounds of 33 per cent protein equivalent ammoniated molasses. All of the rations were computed so that the amount of protein equivalent and total digestible nutrients were equal in all lots.

It was attempted to keep the silage intake for all lots of heifers equal. This was accomplished except for a few days at the start of the trial and again on January 6 when the Lot 4 heifers went off feed. The silage intake was regulated by the lot of heifers consuming the least amount of silage.

All lots of heifers were fed once daily in the morning.

Silage was put in the bunks first, then the ammoniated molasses, grain and cottonseed meal were poured over the silage so that an even distribution of the supplements would be obtained. The feed was stirred to further insure proper mixing.

Table 1--Daily rations used at the beginning of the experiment. (pounds per head)

lot	atlas sorgo silage	cotton seed meal	milo grain	15% ammoniated molasses	33% ammoniated molasses
1	20.0	1.00	2.00	----	----
2	20.0	0.50	1.60	1.47	----
3	20.0	0.50	2.02	----	0.70
4	20.0	----	2.05	----	1.37

The molasses was put in the furnace room of the hog barn where it was warm and where hot water was available for mixing. The molasses handled quite easily when mixed half and half with hot water and stirred vigorously with a stick before being poured over the silage.

A mixture of steamed bone meal and salt in proportions of two to one was fed free choice. Salt alone also was kept before the heifers at all times and the heifers had free access to water.

Results and Discussion

Some difficulty was encountered, at the start of the experiment, getting the heifers receiving ammoniated molasses on feed. On the morning of the fourth day the amount of silage was decreased to Lots 2 and 4 because they had not consumed all of the

silage that had been given to them the previous three days. Lots 1 and 3 received the original 200 pounds yet on the fourth day but on the fifth morning of the experiment, all the lots received only 150 pounds of silage. On the sixth morning Lots 1, 3 and 4 received 200 pounds of silage and Lot 2 received only 150 pounds of silage. On the seventh morning Lot 2 also received 200 pounds of silage, so all lots again were receiving the same amount of silage. However, the 33 per cent protein equivalent ammoniated molasses was somewhat unpalatable and on January 6 the amount of silage to Lot 4 was reduced to 100 pounds per day for seven days, and then increased to 150 pounds per day for two days before the amount of silage for Lot 4 was again to 200 pounds per day, which was the amount being fed to the other three lots of heifers.

On the morning of the seventh day, the heifers in Lot 4 were mixed with a lot of steers next to them and the board fence between the two lots had been broken. The heifers appeared normal, with the exception of one heifer that appeared to walk with a staggering gait, so it was presumed that something had frightened them. The heifers were replaced in their respective lot and the fence was repaired.

On the morning of December 24, or on the eighth morning of the trial, all three lots of heifers receiving ammoniated molasses --Lots 2, 3 and 4--were mixed and again the board partitions between the lots were shattered. Several of the heifers were acting in a cragy manner and showed signs of being bruised from hitting the fences. They would walk with a staggering gait, then

they would lurch into whatever was in front of them. One heifer had hit the fence sc hard, she knocked out a piece of a jaw bone containing several teeth.

The molasses was immediately withheld from the three lots of heifers and cottonseed meal was fed in place of the ammoniated molasses. The heifers in Lot 1 showed no signs of excitement and were eating all the feed that was given to them.

Molasses was withheld for a total of six days after excitement was detected and on the seventh day, the original rations were again given to all lots of heifers.

The 33 per cent protein equivalent ammoniated molasses appeared more unpalatable than the 15 per cent product. The animals would lick the 15 per cent protein equivalent ammoniated molasses but they did not seem to like the taste of the 33 per cent protein equivalent ammoniated molasses. The heifers in Lot 4 receiving 13.75 pounds of the 33 per cent protein equivalent ammoniated molasses refused to eat all their silage and the amount of silage had to be reduced to 100 pounds per day for that lot of 10 heifers.

On January 6, or the twenty-first day of the trial, excitement was again noticed in Lot 4. On January 9, cottonseed meal was given to Lot 4 to replace the ammoniated molasses in the ration. About this same time, excitement was detected in the heifers in Lot 3, so the rations were revised to reduce the amount of ammoniated molasses in the rations for Lots 2, 3 and 4 and to add cottonseed meal in Lot 4.

The rations were revised (Table 2) so that Lot 2 received 14 pounds of 15 per cent protein equivalent ammoniated molasses, a reduction of only 0.7 pound per day for the lot of 10 heifers. Lot 3 heifers were given 5 pounds of 33 per cent protein equivalent ammoniated molasses, a decrease of 2 pounds per day, and Lot 4 had a sharp decrease of 33 per cent protein equivalent ammoniated molasses from 13.75 pounds to 3.3 pounds per day for the lot of 10 heifers. The cottonseed meal was increased from zero to 7.5 pounds per day for Lot 4. The control ration for Lot 1 remained unchanged.

Table 2--Daily rations used starting January 13, 1954. (pounds per head)

lot	atlas sorgo silage	cotton seed meal	milo grain	15% ammoniated molasses	33% ammoniated molasses
1	20.0	1.00	2.00	----	----
2	20.0	0.50	1.60	1.40	----
3	20.0	0.50	2.00	----	0.50
4	20.0	0.75	2.00	----	0.33

Everything went well with these rations until March 10 when excitement was detected in the heifers in Lot 2 receiving 14 pounds of the 15 per cent protein equivalent ammoniated molasses per day. At that time Lot 2 was put on a control ration (Table 3) of 250 pounds of atlas sorgo silage, 20 pounds of ground milo grain and 10 pounds of cottonseed meal per day for the 10 heifers. They remained on the control ration for the remaining 56 days of the experiment.

Table 3--Daily rations for the final 56 days of the trial. (pounds per head)

lot	atlas sorgo silage	cotton seed meal	milo grain	15% ammoniated molasses	33% ammoniated molasses
1	25.0	1.00	2.00	----	----
2	25.0	1.00	2.00	----	----
3	25.0	0.50	2.00	----	0.50
4	25.0	0.75	2.00	----	0.33

It was not known why the ammoniated molasses caused "stimulation" to the heifers. "Stimulation" refers to the excitement or abnormal actions of the heifers. It is a term wrongly used to explain that the heifers had a central nervous system disorder. They became excited to the extent that they walked and ran with a staggering gait. They acted as if they were blinded and would run into anything in their path, as evidenced by the broken boards that seperated the lots of heifers. There have been several theories but no definite proof as to the mode of action. Some of the veterinary staff at Kansas State College cooperated by taking blood samples from excited heifers and running an analysis for blood urea content. The veterinary laboratory was not equipped to run a blood ammonia analysis, so that test could not be run. It was the opinion of the veterinary staff that the symptoms of the excitement were similar to symptoms of alkalosis.

It was thought that perhaps the pH of the ammoniated molasses was not right, so a sample was taken to the laboratory for a pH reading. Both types of ammoniated molasses had a pH near neutral, or pH 7, which was thought to be the desired pH. The

ammoniated products used in this trial had been neutralized with sulfuric acid.

The average daily gain for the three lots of heifers receiving the ammoniated molasses was very erratic throughout the trial (Table 4). However, the gains seemed to be directly influenced by the amount of ammoniated molasses they were consuming and the previous treatment of the animals. As seen earlier in this discussion, much difficulty was encountered the first month due to extensive excitement.

Table 4--Average daily gain by 28-day weigh periods. (pounds)

Lot	1	2	3	4
1st. 28-day period	1.84	1.11	0.86	0.40
2nd. 28-day period	1.75	1.05	1.41[2]	1.57[1]
3rd. 28-day period	1.66	1.11	1.48	1.84
4th. 28-day period	1.51	1.43[3]	0.96	1.37
5th. 28-day period	1.16	1.74	1.23	1.26
Average (140 days)	1.59	1.29	1.19	1.29

[1] Ammoniated molasses (33%) reduced to 0.33 pound and cottonseed meal increased to 0.75 pound at end of first 28-day period.
[2] Amount of ammoniated molasses reduced from 0.7 pound to 0.5 pound per head daily.
[3] Molasses removed completely because of excitement. Animals put on control ration.

The heifers were weighed at 28-day intervals and at the end of the first 28-day period, the heifers in Lot 4, which were receiving 13.75 pounds of 33 per cent protein equivalent ammoniated molasses, had gained only 114 pounds, or an average of 0.4 pound per head per day. During this same period, the heifers in Lot 1, which were receiving no molasses, gained 516 pounds, or an average of 1.84 pounds per head per day. Lot 2 had the next best

gain for the first period with 1.11 pounds gain per head per day and Lot 3 had an average daily gain of 0.86 pound per head per day. It can readily be seen in this first period that the gains were inversely proportional to the amount of nitrogen fed as non-protein nitrogen. The only protein being fed to Lot 4 was that protein in the ground milo grain and silage. Lots 2 and 3 were receiving 0.5 pound of cottonseed meal. The heifers in Lot 1 were receiving one pound of cottonseed meal per head per day and no ammoniated molasses.

The calculated per cent of crude protein furnished by the seperate ingredients in the ration during the first 28-day period can be seen in Table 5. Lots 2 and 3 were receiving about 19 per cent of their crude protein in the form of non-protein nitrogen and Lot 4 was receiving about 38 per cent of its crude protein as non-protein nitrogen. Apparently the non-protein nitrogen was not available for protein synthesis or else the microorganisms in the paunch had not yet become adapted to the ingredients for protein synthesis. There is also the possibility that physiologic disturbances were too great for proper protein metabolism.

Table 5--Calculated per cent of protein equivalent furnished by ration ingredients at the start of the experiment.

Lot	1	2	3	4
	protein equivalent (%)			
Ingredient				
Atlas sorgo silage	46	46	45	45
Cottonseed meal	35	18	17	--
Ground milo grain	19	17	19	17
Ammoniated molasses (15%)	--	19	--	--
Ammoniated molasses (33%)	--	--	19	38
Total	100	100	100	100

The rations were revised starting January 13, 1954, for Lots 3 and 4 (Table 6) so Lot 3 was receiving only 15 per cent of the total crude protein equivalent from non-protein nitrogen. The ration for the Lot 4 heifers was radically revised so that they received only nine per cent of the total crude protein from non-protein nitrogen. At the same time, cottonseed meal provided about 26 per cent of the total crude protein for the Lot 4 heifers.

Table 6--Calculated per cent of protein equivalent furnished by ration ingredients starting January 13, 1954.

Lot	1	2	3	4
		protein equivalent (%)		
Ingredient				
Atlas sorgo silage	46	46	47	46
Cottonseed meal	35	18	18	26
Ground milo grain	19	17	20	19
Ammoniated molasses (15%)	--	19	--	--
Ammoniated molasses (33%)	--	--	15	09
Total	100	100	100	100

A rapid response to this critical change in rations was noted at the end of the second 28-day period. The heifers in the control lot made gains similar to those made during the first period, whereas the heifers in Lots 3 and 4 made a rapid recovery. The Lot 3 heifers increased from 0.86 to 1.41 pounds gain per head per day and the Lot 4 heifers increased their average daily gains from 0.4 to 1.47 pounds per head per day. The Lot 2 group were still on the original ration and made gains similar to the first 28-day period.

At this time the Lot 4 heifers were beginning to take on a slicker appearance after appearing quite ragged at the end of the

first 28-day period. The control heifers in Lot 1 showed plenty of bloom and carried a nice appearance all the way through the trial.

There were no ration changes during the third 28-day period and gains were very similar to those of the previous period. Lot 1 decreased in average daily gains from 1.75 to 1.66 pounds per head. Lot 2 increased 0.06 pound from 1.05 to 1.11 pounds per head per day average gain. Lot 3 increased its average daily gain per head from 1.41 to 1.48 pounds. The Lot 4 heifers were still showing signs of recovery and again increased their average daily gains per head from 1.57 to 1.84 pounds.

At the end of the third weigh period, the Lot 2 heifers, which were receiving 14 pounds of the 15 per cent protein equivalent ammoniated molasses, were still showing signs of excitement as indicated by a staggering gait. The molasses was removed from the ration for the final 56 days of the trial and the heifers were placed on the control ration which was the same as that being fed to the Lot 1 heifers.

The heifers in Lot 2 also showed an immediate response after the ammoniated molasses was taken out of the ration. For the fourth period, they had an average daily gain of 1.43 pounds per head. That was an increase of 0.31 pound per head per day. The other three lots of heifers had a decrease in average daily gains with Lots 3 and 4 showing the greatest decreases (Table 4). Lot 3 decreased from 1.48 to 0.96 pound and Lot 4 decreased from 1.84 to 1.37 pounds gain per head per day. The heifers in Lot 1 had a small decrease from 1.66 to 1.51 pounds per head per day

for the 28-day period.

The final 28-day period showed the Lot 1 heifers, which received the control ration for the entire trial, having the smallest average daily gain for that period. Their average gains decreased from 1.51 pounds to 1.16 pounds per head per day. As shown later, part of this decrease could be attributed to the fact that these heifers were not receiving all the silage that they were capable of consuming. The Lot 2 heifers were still responding to the withdrawal of ammoniated molasses from the ration and gained an average of 1.74 pounds per head per day for the final 28-day period. The Lot 3 heifers had an average daily gain of 1.23 pounds, or an average increase of 0.27 pound per head per day, while the Lot 4 heifers had a slight decrease from 1.37 to 1.26 pounds average gain per head per day for the final 28 days.

It was attempted throughout the trial to keep the silage intake equal for all lots of heifers. Difficulty was encountered for several days during the first month due to a large amount of excitement and to the molasses products being somewhat unpalatable. After the first 28 days, the amount of silage intake was kept equal and was regulated by the lot of heifers eating the least amount. The control heifers in Lot 1 could have eaten more and probably would have responded better toward the end of the trial if they had been given all they could consume. The control heifers would consume 275 pounds or more of silage at the termination of the trial but the other three lots of heifers

would not eat that amount.

With 250 pounds of silage being fed it is calculated that each animal in Lot 1 received 6.9 pounds of total digestible nutrients per day in the ration. According to the energy requirements of beef calves as given in the U.S.D.A. Technical Bulletin 1071, that is enough TDN to allow a 500 to 600 pound calf to gain a pound a day. About 8.0 pounds of TDN would have been needed for 1.5 pounds of gain per head per day when the heifers reached the heavier weights between 500 and 600 pounds. Because the TDN was low during the latter part of the trial, gains for the Lot 1 heifers were correspondingly low.

At the end of the 140-day feeding trial, the control heifers in Lot 1 had increased in weight from an average of 356.9 pounds to an average of 578.9 pounds, or an average of 1.59 pounds per head per day (Table 7). The Lot 2 heifers had an initial average weight of 358.8 pounds per head and a final average weight of 539.2 pounds for an average daily gain of 1.29 pounds per head. The heifers in Lot 3 had the smallest gains in the trial with an average daily gain of 1.19 pounds per head per day for the 140 day trial. They averaged 358.0 pounds at the beginning of the experiment and had an average weight of 524.4 pounds when the experiment ended. The group of heifers in Lot 4 had gains equal to those in Lot 2 for the 140-day period. They averaged 357.6 pounds at the start and weighed out at an average of 538.4 pounds per head for an average daily gain of 1.29 pounds per head per day. This shows a difference of 0.3 and 0.4 pound of gain per head per day in favor of the heifers receiving no ammoniated

molasses in the ration.

It was necessary a few times during the trial to substitute one kind of molasses for another because of a delay in receiving more molasses. When a substitution was necessary, it was attempted to keep the amount of non-protein nitrogen equal.

On March 10, 1954, and again on March 17, 1954, each lot of heifers was given a bale of wheat straw to see if one lot craved it more than another. There was no detectable difference. All the lots ate some of the straw but probably more than half of it was pulled out of the bunks and trampled under foot.

There was also no appreciable difference in the amount of the salt and steamed bone meal mixture that each lot of heifers consumed.

The heifers receiving no ammoniated molasses required the least feed per 100 pounds of gain (Table 7), consuming an average of 1669.2 pounds of feed for each 100 pounds of gain compared to 2072.6, 2238.2 and 2019.7 pounds of feed per 100 pounds of gain for Lots 2, 3 and 4 respectively.

At the end of the trial, the control heifers definitely had a slicker appearance and showed more bloom than the other three lots of heifers that received ammoniated molasses in the ration. The Lot 2 heifers, which had been on a control ration for 56 days were also beginning to show some bloom.

It was noted throughout the trial that the heifers receiving the ammoniated molasses in the ration had watery eyes. Two or three times toward the start of the trial, the heifers were

treated with a sulfa drug to wash out their eyes. These symptoms were not noticed in the control lot of heifers to a great extent.

Table 7--Results of feeding ammoniated molasses in wintering rations of beef heifer calves. December 17, 1953-May 5, 1954.

Lot	1	2	3	4
Number heifers per lot	10	10	10	10
Number days on trial	140	140	140	140
Av. initial wt. of heifers, lbs.	356.9	358.8	358.0	357.6
Av. final wt. of heifers, lbs.	578.9	539.2	524.4	538.4
Av. gain per heifer, lbs.	220.0	180.4	166.4	180.8
Av. daily gain per heifer, lbs.	1.59	1.29	1.19	1.29
Av. daily ration per heifer, lbs.:				
Sorghum silage	23.54	23.46	23.54	22.93
Ground milo grain	2.00	1.76	2.00	2.01
Cottonseed meal (41%)	10.00	7.21	5.21	6.77
Ammoniated molasses (15%)	--	0.71[3]	0.04[2]	0.03[2]
Ammoniated molasses (33%)	--	0.05[1]	0.49	0.44
Salt	ad lib	ad lib	ad lib	ad lib
Salt, steamed bone meal	ad lib	ad lib	ad lib	ad lib
Total feed consumed, lbs.:				
Sorghum silage	32950	32850	32950	32100
Ground milo grain	2800	2464	2805	2814
Cottonseed meal	1400	1010	730	948
Ammoniated molasses (15%)	----	1000	52[2]	42[2]
Ammoniated molasses (33%)	----	65[1]	687	622
Total gain, lbs.	2220	1804	1664	1808
Feed per 100 lbs. gain, lbs.:				
Sorghum silage	1480.0	1821.0	1980.0	1775.0
Ground milo grain	126.1	136.6	168.6	155.6
Cottonseed meal	63.1	56.0	43.9	52.4
Ammoniated molasses (15%)	----	55.4	4.4[2]	2.3[2]
Ammoniated molasses (33%)	----	3.6[1]	41.3	34.4
Total feed per 100 lbs. gain, lbs.	1669.2	2072.6	2238.2	2019.7

[1] Substituted due to delay in receiving 15% molasses.
[2] Substituted due to delay in receiving 33% molasses.
[3] No molasses fed the last 56 days of the trial.

There were no definite signs of diuresis in any of the lots of heifers but the feces in the molasses fed heifers were definitely looser than in the control group of heifers.

One heifer in Lot 4 lost 42 pounds the first 28 days and

another five pounds the second 28-day period. After that it was never able to recover to its original weight. At the end of the trial it still lacked 17 pounds of weighing as much as it weighed at the start of the experiment. The reason for this loss of weight was unknown. It was graded at the beginning of the trial as being a good quality heifer. It is possible that the ammoniated molasses caused some damage to interfere with physiological functions but it was never definitely noted to have been excited. It was checked for worms and was not seriously infested. It was noted throughout the trial that this heifer was listless but it was seen occasionally at the feed bunk eating feed. This heifer is included in the weights of Lot 4, which puts Lot 4 at an additional disadvantage when weights are analyzed.

The results of this experiment agrees with work done at Mississippi (2) and Clemson (50) indicating that, for some unknown reason, the nitrogen in the ammoniated molasses did not become available for protein synthesis, and gains were consequently low. When adequate protein was added to the ration to meet the daily requirements, gains immediately increased. It also agrees in that disorders of the central nervous system resulted when ammoniated molasses was fed in a wintering ration.

SUMMARY

Forty good quality Hereford heifers, averaging about 358 pounds, were divided as equally as possible by weight, type and appearance into four groups of 10 heifers each. A ration was

computed for each lot so that all lots of heifers received the same amount of crude protein and total digestible nutrients. The starting ration for each lot of heifers was as follows: Lot 1, 20 pounds of atlas sorgo silage, one pound of cottonseed meal, two pounds of milo grain; Lot 2, 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, 1.60 pounds milo grain, and 1.47 pounds of 15 per cent protein equivalent ammoniated molasses; Lot 3, 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, 2.02 pounds of milo grain and 0.7 pound of 33 per cent protein equivalent ammoniated molasses; and Lot 4, 20 pounds of atlas sorgo silage, 2.05 pounds of milo grain and 1.37 pounds of 33 per cent protein equivalent ammoniated molasses.

The rations had to be revised several times throughout the trial due to the unpalatability of the ammoniated molasses and to severe excitement of the heifers.

The Lot 1 heifers remained on the original ration for the entire trial, except that the amount of atlas sorgo silage was increased. The rations were revised for Lots 3 and 4 on January 9, so Lot 3 received 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, two pounds of milo grain and 0.5 pound of 33 per cent protein equivalent ammoniated molasses. Lot 4 received 20 pounds of atlas sorgo silage, 0.75 pound of cottonseed meal, 2.0 pounds of milo grain and 0.33 pound of 33 per cent protein equivalent ammoniated molasses. The Lot 2 ration was revised very little at this time but on March 10 the Lot 2 ration was revised so that they received the same ration as the Lot 1 heifers

for the remaining 56 days of the trial.

All lots of heifers were fed once a day in bunks in the morning. The atlas sorgo silage was placed in the bunks and the ammoniated molasses, ground milo grain, and cottonseed meal were mixed in with the silage to insure an equal distribution of the concentrates.

Severe excitement resulted seven days after the experiment started, causing some heifers receiving the ammoniated molasses to act in a crazy manner.

The ammoniated molasses was somewhat unpalatable, which kept feed intake low, because the silage intake to all lots of heifers was regulated by the lot of heifers that consumed the least amount of silage. Because of this method of regulating the silage intake, the control heifers were not receiving enough atlas sorgo silage and TDN during the latter part of the trial to make maximum gains.

Average daily gains per 28-day period throughout the 140-day trial were very erratic. A small amount of ammoniated molasses in the rations resulted in satisfactory gains whereas a large amount of ammoniated molasses in the ration resulted in poor gains.

The control lot of heifers in Lot 1, which received a ration of atlas sorgo silage, one pound of cottonseed meal and two pounds of ground milo grain per head per day made the best gain for the 140-day trial with an average daily gain of 1.59 pounds per head. The heifers in Lots 2, 3 and 4 made gains of 1.29, 1.19, and 1.29 pounds respectively per head per day for the 140-day period.

CONCLUSIONS

1. The 15 per cent and 33 per cent protein equivalent ammoniated molasses as used in this trial did not prove satisfactory as a source of nitrogen in a wintering ration for Hereford heifers.

2. It appears that the nitrogen in the ammoniated products was not available for protein synthesis in the rumen of the heifers.

3. Severe excitement resulted when ammoniated molasses was included in small amounts in a wintering ration where sorghum (atlas sorgo) silage was used as a source of roughage. The excitement was manifested by the fact that the heifers broke down wooden partitions separating the lots and bruised themselves quite severely in doing so.

ACKNOWLEDGMENT

The author wishes to express his gratitude to everyone who cooperated and assisted with this experiment and the writing of this paper. Special thanks go to Dr. Draytford Richardson, the author's faculty advisor, for his advice, guidance, and assistance.

The cooperation and assistance from Dr. Rufus Cox, Dr. Frank Baker, and Ed Smith from the Animal Husbandry Department, and Dale Wharty and Walter Hilliard, caretakers at the experiment barns, is also greatly appreciated.

Many others too numerous to mention have aided the author in many ways throughout this experiment and he greatly appreciates their cooperation.

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THE VALUE OF AMMONIATED MOLASSES
IN BEEF CATTLE WINTERING RATIONS

by

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B. S., Kansas State College
of Agriculture and Applied Science, 1950

AN ABSTRACT

of

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Animal Husbandry

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1954

Forty good quality Hereford heifers, averaging about 358 pounds, were divided as equally as possible by weight, type and appearance into four groups of 10 heifers each. A ration was computed for each lot so that all lots of heifers received the same amount of crude protein and total digestible nutrients. The starting ration for each lot of heifers was as follows: Lot 1, 20 pounds of atlas sorgo silage, one pound of cottonseed meal, two pounds of milo grain; Lot 2, 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, 1.60 pounds milo grain, and 1.47 pounds of 15 per cent protein equivalent ammoniated molasses; Lot 3, 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, 2.02 pounds of milo grain and 0.7 pound of 33 per cent protein equivalent ammoniated molasses; and Lot 4, 20 pounds of atlas sorgo silage, 2.05 pounds of milo grain and 1.37 pounds of 33 per cent protein equivalent ammoniated molasses.

The rations had to be revised several times throughout the trial due to the unpalatability of the ammoniated molasses and to severe excitement of the heifers.

The Lot 1 heifers remained on the original ration for the entire trial, except that the amount of atlas sorgo silage was increased. The rations were revised for Lots 3 and 4 on January 9, so Lot 3 received 20 pounds of atlas sorgo silage, 0.5 pound of cottonseed meal, two pounds of milo grain and 0.5 pound of 33 per cent protein equivalent ammoniated molasses. Lot 4 received 20 pounds of milo grain and 0.33 pound of 33 per cent protein equivalent ammoniated molasses. The Lot 2 ration was revised

very little at this time but on March 10 the Lot 2 ration was revised so that they received the same ration as the Lot 1 heifers for the remaining 56 days of the trial.

All lots of heifers were fed once a day in bunks in the morning. The atlas sorgo silage was placed in the bunks and the ammoniated molasses, ground milo grain, and cottonseed meal were mixed in with the silage to insure an equal distribution of the concentrates.

Severe excitement resulted seven days after the experiment started, causing some heifers receiving the ammoniated molasses to act in a crazy manner.

The ammoniated molasses was somewhat unpalatable, which kept feed intake low, because the silage intake to all lots of heifers was regulated by the lot of heifers that consumed the least amount of silage. Because of this method of regulating the silage intake, the control heifers were not receiving enough atlas sorgo silage and TDN during the latter part of the trial to make maximum gains.

Average daily gains per 28-day period throughout the 140-day trial were very erratic. A small amount of ammoniated molasses in the rations resulted in satisfactory gains whereas a large amount of ammoniated molasses in the ration resulted in poor gains.

The control lot of heifers in Lot 1, which received a ration of atlas sorgo silage, one pound of cottonseed meal and two pounds of ground milo grain per head per day made the best gain for the 140-day trial with an average daily gain of 1.59 pounds per head.

The heifers in Lots 2, 3 and 4 made gains of 1.29, 1.19, and 1.29 pounds respectively per head per day for the 140-day period.

The 15 per cent and 33 per cent protein equivalent ammoniated molasses as used in this trial did not prove satisfactory as a source of dietary nitrogen.